

40th Workshop on Geothermal Reservoir Engineering 2015

Stanford Geothermal Program Workshop Report SGP-TR-204

**Stanford, California, USA
26 – 28 January 2015**

Volume 1 of 2

ISBN: 978-1-5108-0274-2

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2015) by the Stanford Geothermal Program
All rights reserved.

Printed by Curran Associates, Inc. (2015)

For permission requests, please contact the Stanford Geothermal Program
at the address below.

Stanford Geothermal Program
Joleen Palacios Castro – Program Administrator
Green Earth Sciences Building - Room 097
367 Panama Street
Stanford, CA 94305-2220

Phone: (650) 725-9835
Fax: (650) 725-2099

jpcastro@stanford.edu

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Table of Contents

[Reservoir Engineering](#)

[Field Studies](#)

[Tracers](#)

[Modeling](#)

[Production Engineering](#)

[Injection](#)

[Enhanced Geothermal Systems](#)

[Geochemistry](#)

[Geophysics](#)

[Geology](#)

[Direct Use](#)

[Low Temperature](#)

[General](#)

[Emerging Technology](#)

Reservoir Engineering

Stimulation of Geothermal Reservoirs: Impedance and Efficiency of Thermal Recovery <i>Murad ABUAISHA, Benjamin LORET</i>	21
Validation of a Numerical Reservoir Model of Sedimentary Geothermal Systems Using Analytical Models <i>JaeKyoung CHO, Chad AUGUSTINE, Luis E. ZERPA</i>	33
Experimental and Numerical Studies of Rayleigh-Benard-Darcy Convection at Large Ra, an Analog Representation of a Convective Geothermal System <i>Juvenal LETELIER, Paulo HERRERA, Nicolas MUJICA, Jaime ORTEGA</i>	46
Use of Feedzones to Interpret Subsurface Permeability Controls: A Case Study of Olkaria Geothermal System <i>Daniel SAITET, Eric ROP</i>	55
Modeling for Development Capacity of Dieng Geothermal Field, Indonesia <i>Puji SIRAIT, Ruly H. RIDWAN</i>	65
Natural-State Modeling of Geothermal Reservoir at Ogiri, Japan Using iTOUGH2 <i>Yohei TATEISHI, Ryuichi ITOI, Toshiaki TANAKA, Junichi TAKAYAMA</i>	72
A Geothermal Reservoir Simulator with AD-GPRS <i>Zhi Yang WONG, Roland HORNE, Denis VOSKOV</i>	80

Field Studies

Analysis of Stuck Pipe in Menengai	90
<i>Billy Oketch AWILI</i>	
Multimodal Geothermal Development in the Tularosa Basin, NM	102
<i>Benjamin BARKER, Gregory NASH, Joseph MOORE, Carlon BENNETT</i>	
Confirmation of Hydraulic, Tracer, and Heat Transfer Characterization of a Fractured Bedrock Using Ground Penetrating Radar	107
<i>Matthew BECKER, Georgios TSOFLIAS, Adam HAWKINS, Matthew BAKER</i>	
Well Design and Well Workover to Land Deep Production Casings in the Menengai Field	118
<i>Abraham KHAEMBA</i>	
Modeling of Geysers Response to 3.06.2007 and 3.01.2014 Catastrophic Landslides-Mudflows (Kronotsky Nature Reserve, Kamchatka, Russia)	126
<i>Alexey KIRYUKHIN</i>	
Optimization of Drilling Parameters in Drilling of Geothermal Wells - A Case Study of Well MW-17 in Menengai Field	137
<i>Thomas MIYORA, Magnús Þór JÓNSSON, Sverrir ÞÓRHALLSSON</i>	
Comparison Between Use of Hammer Bits and Roller Cone Bits on Conventional Land Rigs, a Case Study of the Menengai Field	152
<i>Stephen NATO and Dominic MUTAI</i>	
Geothermal Play Fairway Analysis of the Snake River Plain, Idaho	159
<i>Dennis L. NIELSON, John SHERVAIS, Lee LIBERTY, Sabodh K. GARG, Jonathan GLEN, Charles VISSER, Patrick DOBSON, Erika GASPERIKOVA, Eric SONNENTHAL</i>	
Updated Geologic and Geochemical Assessment of the Olkaria III Field Following Recent Expansion to 110MW	168
<i>Lara OWENS, Enrique PORRAS, Paul SPIELMAN, Patrick WALSH</i>	
Natural or Induced: Identifying Natural and Induced Swarms from Pre-production and Co-production Microseismic Catalogs at the Coso Geothermal Field	183
<i>Martin SCHOENBALL, J. Ole KAVEN, Jonathan M.G. GLEN, Nicholas C. DAVATZES</i>	
Examination of a Geothermal System from a Porous Geothermal Reservoir in the Pannonian Basin, in Hungary	194
<i>Aniko TOTH, Tamas KEREKGYARTO, Gyorgy TOTH, Gabor SZITA, David FENERTY</i>	
The Geothermal Potential of CO₂ Based Heat Pumps Used in an Abandoned Coal Mine	203
<i>Aniko TOTH</i>	
The Preston Geothermal Resources: Renewed Interest in a Known Geothermal Resource Area	210

Thomas R. WOOD, Wade WORTHING, Cody CANNON, Carl PALMER, Ghanashyam NEUPANE, Travis L. MCLING, Earl MATTSON, Patrick DOBSON and Mark CONRAD

The Distribution and Utilization Prospect of Karstic Geothermal Resources in Bohai Bay Region of China

[224](#)

Ying ZHANG, Zongquan HU, Zhiliang HE, Pengwei LI, Jianyun FENG, Jiefu SUN, Xinjun CHEN and Xiaoling WU

Tracers

- A Framework for Comparative Inverse Modeling of Tracers for Thermal Breakthrough Forecasting Using Fracture Network Models** [231](#)
Morgan AMES, Phil BRODRICK, Roland HORNE
- Characterization of Fluid Flow System Between Injection and Production Wells by Tritium Tracer Test Analysis** [240](#)
Lingkan Finna CHRISTI, Ryuichi ITOI, Toshiaki TANAKA, Jatmiko Prio ATMOJO
- Predicting Thermal Breakthrough from Tracer Tests: Simulations and Observations in a Low-Temperature Field Laboratory** [249](#)
Adam HAWKINS, Russell ZHAO, Don FOX, Jefferson TESTER, Lawrence CATHLES, Donald KOCH, Matthew BECKER
- Measuring Real-time Concentration of Ionic Tracers and pH in Geothermal Reservoirs Using a Ruggedized Downhole Tool** [264](#)
Ryan HESS, Grzegorz CIESLEWSKI, Timothy J. BOYLE, Steven LIMMER, William G. YELTON, Samuel BINGHAM, Greg STILLMAN
- Application of Stable Isotope Geochemistry to Tracing Recharge and Flow Systems of Fluids in Olkaria Geothermal Field, Kenya** [271](#)
Melissa NKAPIANI, Kennedy KAMUNYA
- Recent Progress on Hydrolyzable Compounds as Thermo-Sensitive Tracers for Investigating the Thermal Drawdown of Geothermal Reservoirs** [282](#)
Mario SCHAFFER, Anne NIEDBALA, Friedrich MAIER, Krzysztof R. IDZIK, Max WILKE, Tobias LICHA
- Laboratory Experiment of Tracer Test in the Two-dimensional Heterogeneous Porous Medium** [289](#)
Masahiro TAKAKI, Ryuichi ITOI, Toshiaki TANAKA

Modeling

Effect of Underground Convective Flows on the Performance of Ground Source Heat Pump Systems	297
<i>Yousef Golizadeh AKHLAGHI, Omer Inanc TUREYEN and Abdurrahman SATMAN</i>	
A Regression Analysis on the Geothermal Monitoring Data and Resources Evaluation	306
<i>Cheng BIAN</i>	
Numerical Modeling of Flow Induced Shear Failure in Fractured Reservoirs	313
<i>Rajdeep DEB, Patrick JENNY</i>	
Induced Earthquake Sequences in Geothermal Settings: Data Trends and Modeling Approaches	325
<i>David DEMPSEY, Jenny SUCKALE</i>	
Laser-Enhanced Drilling and Laser-Assisted Fracturing for Subsurface EGS Applications	338
<i>Souheil EZZEDINE, Sasha RUBENCHIK, Robert YAMAMOTO</i>	
Analysis of Fracture Network Response to Fluid Injection	345
<i>Moien FARMAHINI-FARAHANI, Ahmad GHASSEMI</i>	
Influence of Fracture Shearing on Fluid Flow and Thermal Behavior of an EGS Reservoir - Geothermal Code Comparison Study	355
<i>Ahmad GHASSEMI, Sharad KELKAR, and Mark MCCLURE</i>	
Numerical Modeling of the Edremit Geothermal Field, Balikesir-Turkey	369
<i>Emre GUNAY, Nurkan KARAHANOGLU</i>	
Micro-earthquake Analysis for Reservoir Properties at the Prati-32 Injection Test, the Geysers, California	387
<i>Lawrence HUTCHINGS, Brian BONNER, Steve JARPE, and Ankit SINGH</i>	
Three-dimensional Investigation of Hydraulic Treatment in Naturally Fractured Reservoirs	396
<i>Tatyana KATSAGA, Azadeh RIAHI, Branko DAMANANAC</i>	
Geothermal Energy Prospecting of the Yeoman and Winnipeg Formations Within Estevan, Canada	406
<i>Randy KOONKOON, Lotanna UFONDU</i>	
Porosity-Elastic and Self-Propped Single Fracture THM Models for EGS Studies	414
<i>Robert PODGORNEY, George DANKO, Davood BAHRAMI, Pengcheng FU, Mark WHITE</i>	
3D Conceptual Modeling Based on Geophysical and Geological Information for Targeting Geothermal Prospect Area in Hidden Geothermal System	434
<i>Angga Bakti PRATAMA, Wahyu SRIGUTOMO, SURYANTINI</i>	
Anomalous Solute and Heat Diffusion in Fault Structures	446

Anna SUZUKI, Toshiyuki HASHIDA, Kewen LI and Roland N. HORNE

Numerical Study of the Thermal-Hydraulic-Mechanical Behavior of Fractured Geothermal Reservoirs [458](#)

WANG Shihao, WU Yu-Shu, Philip H. WINTERFELD, Luis E. ZERPA

Play Fairway Projects Initiated by the Department of Energy [379](#)

Mike WEATHERS, Eric HASS, Holly THOMAS, Mark ZIEGENBEIN, Alexandra PRISJATSCHEW, Laura GARCHAR, Brittany SEGNERI, Sara EMMONS

Code Comparison Study Fosters Confidence in the Numerical Simulation of Enhanced Geothermal Systems [473](#)

Mark D. WHITE and Benjamin R. PHILLIPS

Using GTO-Velo to Facilitate Communication and Sharing of Simulation Results in Support of the Geothermal Technologies Office Code Comparison Study [485](#)

Signe WHITE, Sumit PUROHIT, Lauren BOYD

Scale Model of Stress Sensitivity for Fractured Low-Permeability Reservoirs [495](#)

Haifeng ZHAO, Jun SHI, Erfeng Mu, Hang CHE, Guohua LIU

Production Engineering

Analysis of Wellhead Temperature Derivatives During Production from Geothermal Reservoirs [501](#)

Kaan KUTUN, Omer Inanc TUREYEN, and Abdurrahman SATMAN

Successful Perforation Operation Experience in a Geothermal Well of Salavatli Geothermal Field [513](#)

Umran SERPEN, Niyazi AKSOY

Determination of Calcite Scaling in OW-903, OW-911 and OW-914 of the Olkaria Domes Field, Kenya [519](#)

Ruth WAMALWA

Injection

Injection-Triggered Seismicity: an Investigation of Porothermoelastic Effects Using a Rate- and-State Earthquake Model [524](#)

Jack NORBECK, Roland HORNE

Reservoir Response to Thermal and High-pressure Well Stimulation Efforts at Raft River, Idaho [536](#)

Mitchell PLUMMER, Hai HUANG, Robert PODGORNEY, Joseph MOORE, Jacob BRADFORD, Mary OHREN

Enhanced Geothermal Systems

Deformation at Brady Hot Springs Geothermal Field Measured by Time Series Analysis of InSAR Data	545
<i>S. Tabrez ALI, Nicholas C. DAVATZES, Kurt L. FEIGL, Herb F. WANG, William FOXALL, Robert J. MELLORS, John AKERLEY, Ezra ZEMACH, Paul SPIELMAN</i>	
Hybrid Low-Grade Geothermal-Biomass Systems for Direct-Use and Co-Generation: from Campus Demonstration to Nationwide Energy Player	550
<i>Koenraad F. BECKERS, Maciej Z. LUKAWSKI, Gloria A. AGUIRRE, Sean D. HILLSON, and Jefferson W. TESTER</i>	
Recent Thermal and Hydraulic Stimulation Results at Raft River, ID EGS Site	561
<i>Jacob BRADFORD, Joseph MOORE, Mary OHREN, John MCLENNAN, William L. OSBORN, Ernie MAJER, Greg NASH, Robert PODGORNEY, Barry FREIFELD</i>	
Results from Newberry Volcano EGS Demonstration	572
<i>Trenton T CLADOUHOS, Susan PETTY, Matthew E. UDDENBERG, Michael SWYER</i>	
Estimating In-situ Permeability of Stimulated EGS Reservoirs Using MEQ Moment Magnitude: an Analysis of Newberry MEQ Data	584
<i>Yi FANG, Derek ELSWORTH, Trenton CLADOUHOS</i>	
Shallow EGS Resource Potential Maps of the Cascades	594
<i>Zachary FRONE, Maria RICHARDS, David BLACKWELL, Chad AUGUSTINE</i>	
Fault Reactivation Due to Thermal Drawdown in Enhanced Geothermal Reservoirs	608
<i>Quan GAN, Derek ELSWORTH</i>	
The Radiator-EGS System: A Fresh Solution to Geothermal Heat Extraction	620
<i>Peter GEISER, Bruce MARSH, Markus HILPERT</i>	
Enhanced Geothermal Reservoirs with Two Fluid Cavities and Unequal Solid and Fluid Temperatures	632
<i>Rachel GELET, Benjamin LORET, Nasser KHALILI</i>	
Thermal Drawdown-induced Flow Channeling in A Single Heterogeneous Fracture in Geothermal Reservoir	644
<i>Bin GUO, Pengcheng FU, Yue HAO, Charles R. CARRIGAN</i>	
Asymptotic Analysis of Thermal Stimulation of Geothermal Reservoirs	654
<i>Kyungjae IM, Derek ELSWORTH, Yi FANG</i>	
Seismic and Aseismic Deformations Occurring During EGS Stimulation at the Geysers: Impact on Reservoir Permeability	663
<i>Pierre JEANNE, Antonio Pio RINALDI, Jonny RUTQVIST, Patrick F. DOBSON</i>	
Fracture Sustainability in EGS Systems – Results of Laboratory Studies	676

Timothy J. KNEAFSEY, Seiji NAKAGAWA, Patrick F. DOBSON, B. Mack KENNEDY

Design Considerations for Applying Multi-Zonal Isolation Techniques in Horizontal Wells in a Geothermal Setting [685](#)

Jeffrey OLSEN, Chad AUGUSTINE, Alfred EUSTES, William FLECKENSTEIN

An Update of the Geothermal Potential in the Continental Rift Zone of the Büyük Menderes, Western Anatolia, Turkey [690](#)

Nevzat ÖZGÜR and Ismail Hakki KARAMANDERESİ

Fracture Characterization Using Resistivity Measured at Different Frequencies in Rocks [697](#)

Baozhi PAN, Kewen LI, Roland HORNE

Proppant Transport Simulations in Discrete Fracture Network Model for EGS [707](#)

Sogo SHIOZAWA, Mark MCCLURE

Thermo-Hydro-Mechanical Modeling of Enhanced Geothermal Systems Using COMSOL Multiphysics [718](#)

Danijela SIJACIC, Peter A. FOKKER

Thermal-Hydrological-Mechanical-Chemical Modeling of the 2014 EGS Stimulation Experiment at Newberry Volcano, Oregon [728](#)

Eric SONNENTHAL, Torquil SMITH, Trenton CLADOUHOS

Microseismicity During the 2005 Habanero EGS Stimulation in the Cooper Basin of South Australia [733](#)

Dennise TEMPLETON, David HARRIS

Investigation of Multiple Seismic Parameters as Indicators of EGS Favorability [736](#)

Ileana TIBULEAAC, Joe IOVENITTI

Simulation of Slip-Induced Permeability Enhancement Accounting for Multiscale Fractures [743](#)

Eren UCAR, Inga BERRE, Eirik KEILEGAVLEN

The Evolution of Surface Roughness and Aperture in Natural Fractures Subjected to Repeated Slip [756](#)

Olivia WELLS, Nicholas C. DAVATZES

Developing Improved Methods for the Assessment of Enhanced Geothermal Systems [768](#)

Colin WILLIAMS and Jacob DEANGELO

Numerical Simulation of Heat Production Potential from an Enhanced Geothermal System in Northern Songliao Basin, Northeast China [777](#)

Yanjun ZHANG and Zhengwei LI

Geochemistry

- Modeling of Calcite Scaling and Estimation of Gas Breakout Depth in A Geothermal Well by Using PHREEQC** [783](#)
Taylan AKIN, Aygün GÜNEY, Hulusi KARGI
- A Review of Scaling Mechanisms and Minerals in Hveragerði District Heating System** [791](#)
Almar BARJA, Einar Jón ÁSBJORNSSON, Sverrir THORHALLSSON, Vigdís HARDARDOTTIR
- He Isotopic Evidence for Undiscovered Geothermal Systems in the Snake River Plain** [798](#)
Patrick F. DOBSON, B. Mack KENNEDY, Mark CONRAD, Travis MCLING, Earl MATTSON, Thomas WOOD, Cody CANNON, Ross SPACKMAN, Matthijs VAN SOEST, Michelle ROBERTSON
- Overview of Geochemical Modeling for Geothermal Energy: Model Description and Uncertainty Quantification** [805](#)
Souheil EZZEDINE
- Regional Assesment Using Graphical Techniques of Indonesian Non-Volcanic Geothermal System in Central Sulawesi, Indonesia: Based on Fluid Geochemistry** [814](#)
Ali FAHRURROZIE, Yosi AMELIA, Andri Eko Ari WIBOWO
- Integrated Geochemical Investigations of Surprise Valley Thermal Springs and Cold Well Waters** [821](#)
Andrew FOWLER, Carolyn CANTWELL, Nicolas SPYCHER, Drew SILER, Patrick DOBSON, Mack KENNEDY, Robert ZIERENBERG
- Application of Silica Heat Flow on Geothermal Water Circulation Depth Estimation in the Chingshui Geothermal Field, Taiwan** [830](#)
Ching-Huei KUO, Chia-Mei LIU, Sheng-Rong SONG, Yu-Wei TSAI
- Integrating Geothermometer and High Resolution Thermometer to Characterize the Geothermal Characteristics of Ilan Plain, Taiwan** [836](#)
Chia-Mei LIU, Hsieh-Tang CHIANG, Ching-Huei KUO, Sheng-Rong SONG, Yu-Wei TSAI
- Validation of Multicomponent Equilibrium Geothermometry at Four Geothermal Power Plants** [842](#)
Ghanashyam NEUPANE, Jeffrey S. BAUM, Earl D. MATTSON, Gregory L. MINES, Carl D. PALMER, and Robert W. SMITH
- High-Temperature Illite Dissolution Kinetics** [859](#)
Megan SMITH, Susan CARROLL

Geophysics

- Anisotropic Elastic-Waveform Modeling for Fracture Characterization in EGS Reservoirs** [868](#)
Kai GAO and Lianjie HUANG
- Mapping the Geothermal System Using Audio Magnetotellurics and Magnetotellurics in QP Geothermal Field, SW Tibet** [875](#)
HE Lanfang, Dorji, ZHA Yabing, ZHAO Xuefeng and XI Xiaolu
- Elastic-Waveform Inversion with Compressive Sensing for Sparse Seismic Data** [882](#)
Youzuo LIN and Lianjie HUANG
- 3-D Full-tensor Magnetotelluric Analysis of Coso Geothermal Field** [887](#)
Nathaniel J. LINDSEY, Gregory A. NEWMAN
- Large Scale Geothermal High in the Westernmost North American Covered Craton – Can Heat Flow Vs. Basement Heat Production Be a Reliable Tool in Predicting Deep EGS Geothermal Resource?** [895](#)
Jacek MAJOROWICZ and Simon WEIDES
- Virtual Seismometers in Geothermal Systems: Using Microquakes to Illuminate the Subsurface** [904](#)
Eric MATZEL, Christina MORENCY, Dennise TEMPLETON, Moira PYLE
- Joint Inversion of Geothermal Prospects** [908](#)
Robert. J. MELLORS, Andrew TOMPSON, Xianjin YANG, Jeffery WAGONER, Mingjie CHEN, Kathleen DYER, and Abelardo RAMIREZ
- Imaging Geothermal Resources with 3D Seismic Attributes** [913](#)
Robert J. MELLORS, Naomi MARKS, Satish PULLAMMANAPPALLI, John CASTEE, Trent YANG, Joseph MOORE and Clay G. JONES
- Dynamic Hydro-geomechanical Simulation of Earthquakes Induced by Fluid Injections in Geothermal Reservoirs** [918](#)
Mamun MIAH, Laura Blanco MARTIN, William FOXALL, Christopher MULLEN, Lawrence HUTCHINGS
- Application of Comprehensive Geophysical Methods to the Geothermal Field Investigation** [925](#)
WANG Xuben, HE Lanfang, ZHAO Xiaoming, YU Nian

Geology

- Characteristics of Geothermal Reservoirs and Structural Geology for the Yangbajing Geothermal Field: A Case Study for Formation of Geothermal Resources in South the Nyaiqentanglha of Tibetan Plateau** [933](#)
Jianyun FENG, Zhiliang HE, Ying ZHANG, Zongquan HU, Pengwei LI
- Case Study: Reservoir Quality in Sedimentary Geothermal Settings in Australia** [941](#)
Martin HAND, Pavel BEDRIKOVETSKI, Cameron HUDDLESTONE-HOLMES, Alex BADALYAN, Zhenjiang YOU, David BRAUTIGAN, Antoine DILLINGER, Themis CARAGEORGOS, Hani Farouq ABUL KHAIR, Betina BENDALL, Chris MATTHEWS
- Structural Geology of Eburru Volcano and Badlands Geothermal Prospects in Kenya** [955](#)
Rose KIENDE and Risper KANDIE
- Structural Permeability Assessment Using Geological Structural Model Integrated with 3D Geomechanical Study and Discrete Fracture Network Model in Wayang Windu Geothermal Field, West Java, Indonesia** [965](#)
Asrizal MASRI, Colleen BARTON, Lee HARTLEY, Yuris RAMADHAN
- Geothermal Well Targeting Method Using Structural Irregularities** [977](#)
Glenn MELOSH

Direct Use

Current Status and Developing Trend of Direct Use in Global Geothermal Resource [987](#)

Yuanquan HUANG

Direct Heat Geothermal Installation Preserves a Historic Building [995](#)

Jon LEAR, Benjamin BARKER

Low Temperature

**Use of a Horizontal Heat Exchanger to Generate 250 kWe Inside the Guayabo Caldera:
Guanacaste, Costa Rica** [999](#)

Olman ARIAS-MOLINA, Orlando BARRIOS-RODRIGUEZ

Geothermal System of North China Fault Basin: Insight from Xiongqian Geothermal Field [1003](#)

LI Pengwei, HE Zhiliang, HU Zongquan, LIU Jinxia, Zhang Ying, FENG Jianyun, SUN Jiefu, Zou Jing

Assessment of Design Procedures for Vertical Borehole Heat Exchangers [1011](#)

Eleonora SAILER, David Martins Geraldo TABORDA, James KEIRSTEAD

Department of Energy DOE Low Temperature Geothermal Mineral Recovery Program [1022](#)

Holly THOMAS, Timothy P. REINHARDT, Brittany SEGNERI

General

- Assessment of New Approaches in Geothermal Exploration Decision Making** [1032](#)
Sertac AKAR, Katherine R. YOUNG
- Re-evaluation of the Pre-Development Thermal Regime of Roosevelt Hot Springs Geothermal System, Utah** [1042](#)
Rick ALLIS, Mark GWYNN, Christian HARDWICK, Stefan KIRBY, Joseph MOORE, David CHAPMAN
- Geothermal Energy - Making It Renewable and Sustainable** [1054](#)
George Moshe DAYAN, Maureen Nechesa AMBUNYA
- Ancillary Service Revenue Potential for Geothermal Generators in California** [1062](#)
Thomas EDMUNDS, Pedro SOTORRIO
- The Potential for On- and Off-shore High-enthalpy Geothermal Systems in the USA** [1074](#)
Wilfred A. ELDERS
- Optimizing Geothermal Drilling: Oil and Gas Technology Transfer** [1083](#)
Alfred EUSTES, Charles VISSER, Mitch TILLEY, Walt BAKER, Dan BOLTON, Jason BELL, Uneshddarann NAGANDRAN, Ralph QUICK
- KIT Test-hall for Geothermal Tools – Experimental Results and Consequent Engineering Solutions** [1094](#)
Benedict HOLBEIN, Joerg ISELE, Luigi SPATAFORA
- Site Specific Probabilistic Seismic Hazard and Risk Analysis of Induced Seismicity for Surrounding Communities of the Geysers Geothermal Development Area** [1103](#)
Lawrence HUTCHINGS, Jean SAVY, Corinne BACHMANN, Oliver HEIDBAC, Johannes ALTMANN, Mamun MIAH, Nate LINDSEY, Ankit SINGH, and Roselyne LABOSO
- A Procedure for Appraisal of Drilling Success** [1116](#)
Ari INGIMUNDARSON, Helga TULINIUS
- Integration of Environmental Management System in Monitoring of Environmental and Social Aspects Associated with Operation of Olkaria II Geothermal Power Plant at Olkaria in Naivasha Sub-county, Nakuru County, Kenya** [1123](#)
Philip JUMA BARASA
- Geothermal Plant Capacity Factors** [1133](#)
Greg MINES, Christopher RICHARD, Jay NATHWANI, Hillary HANSON, Rachel WOOD
- Geothermal Energy and Biomass Integration in Urban Systems: a Case Study** [1141](#)
Stefano MORET, Léda GERBER, Frédéric AMBLARD, Emanuela PEDUZZI, François MARÉCHAL
- The Geothermal Journey - A Case Example of Iceland and Kenya** [1153](#)

Edna Achieng OUKO, Malfridur OMARSDOTTIR

Particle Tracking Velocimetry Technique Development for Laboratory Measurement of Fracture Flow Inside a Pressure Vessel Using Neutron Imaging [1161](#)

Yarom POLSKY, Philip BINGHAM, Hassina BILHEUX, Daniel HUSSEY, David JACOBSON, and SETH PEMBERTON

The Role of Uncertainty for Lumped Parameter Modeling of Low Temperature Geothermal Resources [1172](#)

Sven SCHOLTYSIK

Zonal Isolation in Geothermal Wells [1182](#)

Arash SHADRAVAN, Mohammadreza GHASEMI, Mehrdad ALFI

A Rational and Practical Calculation Approach for Volumetric Method [1192](#)

Shinya TAKAHASHI, Satoshi YOSHIDA

DOE Geothermal Data Repository: Getting More Mileage Out of Your Data [1204](#)

Jon WEERS, Arlene ANDERSON

Emerging Technology

- Superheating Low-Temperature Geothermal Resources to Boost Electricity Production** [1210](#)
Nagasree GARAPATI, Jimmy B. RANDOLPH, Martin O. SAAR
- Heat Transfer Properties and Dissolution Behavior of Barre Granite as Applied to Hydrothermal Jet Drilling with Chemical Enhancement** [1222](#)
Sean HILLSON, Jefferson TESTER
- Survey on Effective and Feasible Emerging Technologies for EGS Well Drilling** [1231](#)
Shigemi NAGANAWA
- Characteristics of Geothermal Reservoirs in Oceanic Rift Zones** [1237](#)
John ORCUTT and Jim SHNELL
- Assessing Fracture Connectivity Using Stable and Clumped Isotope Geochemistry of Calcite Cements** [1242](#)
Kristina K. SUMNER, Erin R. CAMP, Katharine W. HUNTINGTON, Trenton C. CLADOUHOS, Matt UDDENBERG
- The Artificial Geyser Concept – New Insights** [1254](#)
Catalin TEODORIU; Gioia FALCONE, Johann Goethe ALRUTZ BARCELOS